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REPORT R-1868

SUPPORTING STUDIES ON QDRI PROJECT PLAN

Report No. 1 - PLANNING & PREPARATION

by

JERRY J. SEGAL

September 1967

UNITED STATES ARMY
FRANKFORD ARSENAL
PHILADELPHIA, PA.

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Report No. 1 - PLANNING & PREPARATION

by

JERRY J. SEGAL*

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AMC QDRI Program Office
FRANKFORD ARSENAL
Philadelphia, Pa. 19137

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ABSTRACT

This report covers the procedural aspects of creating a project plan and describing the necessary tasks for the development and implementation of an information processing system. In general terms, the myriad of functions that must be accomplished to develop the system, are presented in a tutorial fashion, to illustrate the techniques involved in the preliminary planning and control phases of an information processing system project. The Qualitative Development Requirements Information (QDRI) System is currently undergoing a transformation from an ad hoc manual operation to a formalized, information system. This report is intended to provide guidance to the Project Manager in formulating a detailed and comprehensive plan to conduct the Project. A subsequent report will convert the general techniques presented here into the formal project plan.

FORWORD

The Qualitative Developments Requirements Information (QDRI) Program of the U.S. Army Material Command is an information program which enables the industrial and academic communities, and the Army to take advantage of the Department of the Army's policy on the exchange of scientific and technical information. QDRI is advance Research and Development Information released by the Army to the industrial and academic communities outlining current and future Army requirements for development programs which are of a qualitative nature only, which for lack of definition and/or solution cannot be placed in procurement channels, and for which the Army seeks assistance.

In order to take advantage of the capabilities inherent in the automation of the QDRI Program and the computer and programming standardization efforts within AMC under the Program for Automated Logistics Management System (PALMS), QDRI will exercise its first generation information processing system as a PALMS Pilot Test. Subsequent QDRI System plans will provide for a more fully automated, sophisticated information storage and retrieval system structured on an on-line network basis.

This report, PLANNING AND PREPARATION, will provide the QDRI Project Manager with a guide in preparing the computer automation sections of the over all QDRI Project Plan. It is intended to serve as a general guide, outlining the major tasks and sub-tasks associated with the automation of information processing systems. As work proceeds under the present contract, performing preliminary analysis of the QDRI System, a subsequent report will convert the principles presented into a more detailed version, forming the QDRI Automation Project Plan.

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QDRI PLANNING & PREPARATION REPORT

A. INTRODUCTION

Establishment of the QDRI Information Processing System requires complete integration of the many facets of QDRI into an operational system. All of the previous efforts relating to feasibility studies, data bank design studies, system design studies, forms design, input formats, report (output) formats, and other related tasks must be combined into a unified set of specifications which will guide the project team in their task of creating and establishing an operational system.

The preparatory tasks that must be accomplished to create the operational system are many, and all critical to the final outcome. The QDRI Program Manager must be aware of the nature, scope, and magnitude of each and every task in order to effectively utilize the economic and technical resources available to him in order to conduct a successful project.

A large and important task is the selection of the operating and supporting teams for the QDRI Information System as well as their training and indoctrination. In addition to the project team training, a similar effort, but on a different magnitude, should also be undertaken for those personnel affected by the new system. Another substantial task is the programming of the system, along

with the development of procedures - both manual and automated - for the operation of the system. Also, conversion of files and records must be accomplished along with the maintenance of these files right up to the time of operational testing. Lastly, but of equal importance is the preparation for on-site testing and assuring that necessary operating supplies are available.

As can be readily observed from the brief descriptions above, the magnitude of the major tasks which must be executed for reaching operational testing status, provide an insight to the prime objectives of project planning and control. The objectives are to:

1. Clearly state, in some detail, the products of the project, the work needed to develop these products, and the conditions under which the effort will be conducted, and:

2. To estimate needed resources and costs in light of elapsed time, manpower, and machine hours.

Further, these stated objectives must be viewed in light of the major characteristics of information systems and their development and also with the characteristics of computer programming projects in mind. Both functions share characteristics such as:

1. Intangible products are "developed" as compared to hardware.

2. The user, in most cases, does not have a clear idea of what is needed, and/or cannot clearly impart the need to system developers.

3. System products and programming processes are subject to frequent changes.

4. Intangibility often results in overemphasis upon tasks that lead to visible "hard" products and underestimation of the difficulty and cost of less tangible tasks such as "supervise", "coordinate", and "evaluate."

Much can be done by the Project Manager to alleviate the problems inherent in these characteristics through adequate documentation. Documentation will provide "Tangible Products" and enable the Project Manager to keep those persons affected by the project, but not directly involved, aware of what is taking place. However, the Project Manager must also be aware of the danger of developing large amounts of expensive, useless documentation.

All of the preparatory tasks and functions mentioned must be accomplished prior to the time of the QDRI System

entering the operational testing phases. Sufficient time must be allocated to all of these tasks since they - singly and in combination - directly determine the effectiveness of the QDRI Information Processing System operational test.

B. PLANNING AND PROGRESS CONTROL

The built-in deadline for the preparatory phase is determined by the date of the start of the operational testing of the QDRI Information Processing System. As a result, schedules are generally developed by working backward, however, the allocation of time for different tasks must still take into account a realistic view of what is to be accomplished. For example, to schedule programming prior to actual indoctrination of the programming staff is courting an immediate slippage of schedules. A useful approach to scheduling and resource allocation, and widely utilized by the Federal Government, is Critical Path Methods (CPM) used in conjunction with Program Evaluation and Review Techniques (PERT).

Realistic schedules can be created only by taking into consideration the tasks to be performed - and their magnitude - and the resources made available to execute them. Estimating time requirements can only be realistically accomplished after the system design phases have been completed and fully understood by the team of analysts assigned the responsibility of developing and preparing detailed specifications of the system. Usually the time allocated for the task determines the levels of manpower required, however, in the case of the QDRI Information Processing System preliminary operational

test plans, tentative manpower levels have been established prior to the preparation of system specifications. This approach to project staffing will necessitate frequent, if not constant, monitoring and review in order to properly and effectively utilize available resources Sufficient time must be allocated to allow the analysts and functional personnel assigned to the project team to become familiar with the current level and degree of the QDRI Information Processing System design. A similar learning period will also be required for the programmer members of the project team.

Progress charting will provide a useful, visual means for determining project status. It can also provide a means for determining corrective action for schedule slippages as well as providing the initial point for monitoring of the entire project. Charting will also create an effective means for project reporting on a regular basis. An important point to consider regarding progress control reporting is the frequency of reporting. Weekly progress reporting should satisfy most needs and yet avoid the pitfalls of too frequent or of infrequent reporting. Obviously, a report on the due date of a particular task announcing - "We didn't make it!" is less useful than a report prior to the due date announcing - "We are not going to make it!" The latter at least permits some sort of corrective action to be attempted.

C. STAFFING AND TRAINING

Generally the staffing for the preparatory phases of an information processing system development project is not the same as the staffing requirements for system operation. Programming manpower requirements are significantly higher during the preparatory phases than for operations. This pattern also functions in the opposite manner for operator (equipment) personnel are not required until the system is ready to go on-the-air. Requirements for clerical type personnel (Keypunchers, etc.) will depend on the magnitude of the data conversion effort necessary to create the files of the operational data bank(s). Scheduling of the conversion task can be over a long enough period of time, thereby allowing for execution by a staff of normal operating size. However, the lengthened period for conversion will complicate the maintenance and updating of the data bank(s) by manual methods.

The personnel selected to implement the QDRI Information Processing System should have the necessary prerequisites and experience to be classified as analysts and programmers respectively, without any additional training other than learning QDRI.

Assigned personnel will be provided with formal indoctrination of the QDRI Information Processing System.

It would be in the best interests of the project to have the analysts and functional personnel assigned, reporting for assignment to the project prior to the programming personnel. By phasing the reporting of personnel, a more efficient working relationship between project management and personnel can readily be established. It is highly significant from a learning viewpoint to have the analysts available for the project first. Because the analysts assigned to the QDRI Project will not perform preliminary systems analysis, but rather make use of previously completed analysis and design tasks, a learning and familiarization process will be required. In addition, during the learning and familiarization process, there is a likely possibility that modifications and improvements in the preliminary system designs will be generated.

The assigned analysts and functional personnel should have available all current QDRI documentation, including the QDRI Managers Guide. (There should be a formal review of QDRI documentation conducted by the AMC QDRI Program Manager.) Once the indoctrination period is completed this portion of the project team can proceed with the task of developing detailed systems and programming specifications. Only after this task is well underway does it become appropriate to bring on-board the programming personnel assigned to the project. It is

then the responsibility of the analysts and functional personnel to conduct the training and indoctrination of the programming personnel assigned to them. In addition, the QDRI Program Manager should also provide the new arrivals to the project team with a generalized introduction to the QDRI Program.

Training should also be provided for the support personnel not directly assigned to the QDRI Information Processing System such as; computer operators; machine room personnel; etc. An unknowledgeable computer operator can cause many unnecessary problems during the preliminary phases of program testing by not being able to correct or detect error conditions that halt testing or processing runs. Machine room personnel can inadvertently issue tapes or disc packs which contain important data for use as scratch tapes which can result in the destruction of hard to replace master records just as can be done through operator errors.

D. SYSTEMS ANALYSIS AND DESIGN

The process of determining the specifications for the system and detailing a set of programs capable of fulfilling them is generally divided into two distinct phases - Systems Analysis and Systems Design. The first phase consists of investigating the information processing requirements that are to be adapted to automatic data processing techniques. This phase, as applied to the QDRI Information Processing System, has been partially accomplished with the preparation of preliminary studies and designs in the past. However, the team of analysts and functional personnel should - in fact must - be given the opportunity to review all prior efforts in detail. This will not only provide these members of the team with an indoctrination but also the opportunity to make positive contributions to the final functional designs. The second phase consists of preparing detailed specifications of the solutions required to make the information processing system function as anticipated.

System analysis and design is a complex process, and for a system such as the QDRI Information Processing System, can be broken down into many phases and fine tasks. The tasks of analysis and design are largely intangible, being carried out as studies or investigations, producing specifications which in turn must then be

translated by programmers into machine instructions. Careful coordination and open lines of communication are required during the analysis and design phases to assure that all functional requirements of the QDRI Information Processing System are met. Changes and modifications to specifications once completed, are costly and certain to create schedule slippages during later phases of the project. It is imperative that the Project Manager supervise and monitor all major tasks. He, and his assistants, must evaluate the results, coordinate all activities, and resolve technical and administrative details. The Project Manager must make or participate in all important technical decisions.

A most important and time consuming task of the Project Manager is the external coordination of analysis and design plans. He represents the "project" in contacts with user personnel at briefings, conferences, and in obtaining concurrence of system designs and specifications. He also represents the "project" to managememt through briefings and presentation of status reports. The Project Manager must also deal with computer operations personnel and other service organizations to arrange for computer time, EAM work, and other necessary support.

Although the major tasks of System Analysis and System Design which are presented in the following

sections apply generally to all projects, their intensity may vary among different projects or even among the many facets of one project. For example, to transfer an ADP application that already exists on one machine to another machine requires little analysis or design because the project already has a "proven" system and program design. On the other hand, if an application (QDRI Information Processing System) is to be prepared for machine utilization for the first time, then much more time must be allocated for system analysis and system design.

SYSTEM ANALYSIS TASKS

Task 1 - Project Planning

Study the system functional requirements and estimate the need for various resources such as manpower, computer time, etc. and prepare planning estimates, project development plans and the project implementation plan.

Task 2 - System Requirements

Determine the operational requirements of the system and evaluate their completeness, feasibility, and compatibility with other similar systems and by studying and coordination with user personnel.

Task 3 - Study the User's Environment

Study the environment and current operation of the application to determine how the system and the equipment will be utilized, where the operation will be based, determine the responsibilities of the user, and to prepare a User's Indoctrination handbook or other related types of documentation.

Task 4 - Computer Program Requirements

Determine the requirements for program production and test, the adequacy of available aids, and the aids required to produce the system by studying the total environment for program production, including computer operations, availability of computer time, availability of back-up equipment, and the kind of programming languages, operating systems, and other programming support available.

Task 5 - Study Similar and Interfacing Systems

Determine if there are any systems, subsystems, procedures, and techniques already in use or planned, that may influence the current project or provide

usetul information for project planning.

Task 6 - Requests for System Changes

Establish procedures for processing requests for changes, receive, evaluate, and respond to requests for changes in system designs, including input formats, reports generated, etc.

SYSTEM DESIGN TASKS

Task 1 - Design the Total System

Develop the total information processing system, and the system configuration (hardware) that will be required to operate the system, and produce a system flow chart and system design document. Documentation at this point in the project becomes most critical and adequate standards should be established, adopted, and adhered to without any compromise.

Task 2 - Design the Computer Program System

Develop the design for the computer programs portion of the total information processing system. Detailed specifications must be prepared for each and every segment of the computer programs required

for the project. These specifications must be carefully documentated and incorporated into the total systems design documentation. Final specifications should also be prepared for the design of the data base and incorporated into the system documentation. General flow diagrams of the programming system are also required for inclusion into system documentation at this time.

Task 3 - Produce the Functional Description

Produce and coordinate a document that describes in detail the system to be developed and the environment within which it is to operate. This document will serve to inform the user and other interested persons, at both working and management levels of the system design and of its expected operation.

Task 4 - Indoctrinate Programmer Personnel

Indoctrinate the programmer members of the project team in the details and design of the programs to be developed. The indoctrination should also include detailed descriptions of the data base, its design

and structuring, and method of utilization.

Although the System Analysis and System Design tasks just described are general in nature, they are applicable to all information processing system development projects. It should also be apparent that each task described is a major task comprised of many smaller sub-tasks, each contributing their part to the entire task. It is this type of similar analysis that is required to develop the complete list of sub-tasks for the development and implementation of the QDRI Information Processing System. The list should be developed and expanded by the team of analysts and functional personnel assigned to the project as part of their concentrated effort in executing Task 1 of the System Analysis phase of the project.

E. PROGRAM DEVELOPMENT AND IMPLEMENTATION

The process of producing programs from a set of system programming specifications is divided into three distinct phases. Phase 1 concerns Program Development. This is the effort required to design programs that will perform assigned operational functions. Phase 2 concerns Program Coding. This effort involves the translation of program specifications into program instructions. Lastly, Phase 3 concerns Program Checkout. This involves the running of programs under test conditions to make certain that they are error free and perform as specified.

The Program Development Phase repeats, on a smaller scale but with a higher level of detail, much of the previous analysis and design process. However, this process is now focused on the programming system component of the information processing system. To create the detailed designs for many programs during the Program Development Phase, the work is usually divided and therefore requires more manpower resources than for System Analysis and System Design. However, a thorough job of analysis and design will reduce the need to collect additional data during this Phase, thereby resulting in potential savings in schedules.

The Program Coding Phase is a straightforward task

once detailed flowcharts or other coding specifications are prepared. However, even in the Program Coding Phase, many opportunities for improvement in the detailed design may be detected or presented to the project team. In actual situations, design efforts do not cease once coding specifications are produced, but continue not only through the Coding Phase but throughout the checkout of the programs. Subject to many errors, program coding requires thorough and constant checking prior to program test to detect and correct all types of errors.

Program Coding is usually done by dividing the programs into many small routines, each of which is coded, compiled, and checked out separately before being combined into larger blocks and finally into a complete program. A great deal of the work of Phase 3 - Program Checkout - then is actually done during this gradual process of code checking. A word of warning however, no matter how thorough code checking is done, there are no guarantees that the program will perform according to specifications, either by itself or in combination with other programs. Testing the performance of the individual programs, and of various program combinations, to insure the performance of the programs is one of the lengthiest and most important aspects of Program Development and Implementation.

The programming effort should be supervised by the systems analyst who prepared the system design the program is intended to implement. The analyst can pass on modifications suggested by the programmers with appropriate comments and recommendations since he can most readily determine their effects on the rest of the system.

One of the most important supervisory tasks is the monitoring of adherence to programming standards and documentation requirements by the programmer staff. Programming standards prescribe and establish certain programming practices that serve to keep programs compatible, make their use easier for computer operators, and allow programmers other than the origionators to work on them. For example, the programming standards may specify the use of COBOL for all programs unless the project manager authorizes the use of another language. The standards also must specify the utility programs available to the system and insist that they be used to forestall wasteful reprogramming and duplication of these operations. This type of information should be obtained through the Data Systems Office.

Programming documentation is one of the standards areas that are most bitterly opposed by programmers, yet it serves at least three purposes of interest to them:

1. Adequate documentation allows the systems analyst to review the programmers initial efforts before he has wasted too much time heading in the wrong direction.

2. Documentation assists the programmer in testing and proving out his program and relieves much of the task of training computer operators to run his program.

3. Documentation enables the programmer (or another programmer) to return to a completed program at any given time and make changes without having to retrace the original program to determine what is going on.

The first step in program development and implementation begins when the programmer develops flow charts for review by the analyst before commencement of coding. Many programmers dislike this task, preferring to start coding immediately from the analysts problem definition. Unless the problem definition is quite detailed, the analyst should insist on the preparation of detailed flow charts in strict accordance with the programming

standards. Final flow charts are essential to the programmer in the checking out of the program. They serve as road maps to his detailed coding and enable him to localize within specific segments of the coding, problems uncovered during checkout.

The entire Program Development and Implementation Phase is dependent upon the availability of time on a computer like the one that will be utilized for operations. If programs are written in machine independent languages such as COBOL or FORTRAN, they must be submitted to a computer for compilation into symbolic language form and subsequently assembled from that form into object or machine language. The compilation and assembly processes usually turn up programmer errors in the use of the language, but not errors in the processing logic because these are beyond the power of the compiler or assembler. However, these language error finds often lead to logic corrections, but the object programs can be proven only by running them with representative test data on a computer that matches the one to be used with the operating system.

During Program Checkout, the project personnel are dependent upon adequate and timely EAM and computer support services, and therefore, close cooperation with machine room and project personnel is mandatory because

slight inefficiences in procedures that tend to increase turnaround time may seriously slow progress in the project. Project personnel need test results as quickly as possible to initiate corrective action when program errors are detected. Interaction during system test may become difficult and costly if the test facility is separated from the programming activity by some distance. For example, the separation may slow the development of procedures for modifying and correcting programs quickly or for finding solutions to design problems.

The project managers task during the programming development and implementation phase is to monitor all activities and review end products. He should try to anticipate and avoid delays of various kinds during this phase. Once initiated, programming activity is delayed by even a proposed change because of the time spent to evaluate the change. Any approved change may result in a considerable amount of work being scrapped as detail designs and data structures are redone and recoded. It behooves the project manager, once programs reach the system testing phases to defer changes to a later version of the system. It is also imperitive to comment that work should not stop and create schedule slippages while decisions on changes are being resolved. Therefore it is critical from a timing and cost viewpoint that quick

decisions on all proposed changes be mandatory.

The following is a presentation of the major tasks associated with Program Development and Implementation. It should also be noted that within each major task there are a varying number of sub-tasks which are highly dependent on the specific project and also the results of the previous analysis and design phases.

PROGRAM DEVELOPMENT TASKS

Task 1 - Programming System Test Plans

Develop and document program system test requirements, test plans, and test designs to provide the specific plans and criteria for program and system evaluation. This is a complex and creative task, and will require close cooperation of all senior personnel assigned to the project.

Task 2 - Design Programs

Design and document the individual programs and routines that have been specified during the System Analysis and System Design Phase. Detail design logic and flow charts for each and every program segment must be prepared along with finalization of all input and output formats.

Task 3 - Design Program Files

Develop and define the form of the data elements to be manipulated by each program. Program storage and data storage allocations must be prepared. All program data structures must be documented and clearly identified.

Task 4 - Establish System Files

Develop and maintain a central accounting system for information used by more than one program in the programming system. Develop documentation of the central file structure including procedures for maintenance and provide periodic listings of the contents of the data bank.

PROGRAMMING IMPLEMENTATION TASKS

Task 1 - Code the Programs

Translate flow diagrams, logic, and other program designs into coded instructions.

Task 2 - Desk Check Programs

Desk check all programs by looking for illegal expressions, erroneous data references, program logic errors, programming inefficiencies, and deviations from programming specifications.

PROGRAM CHECKOUT TASKS

Task 1 - Learn Test Environment and Procedures

Using previously prepared test requirements as a framework, the project team must learn the procedures for using the computer, the utility and other support systems. All available debugging aids should be utilized for the purpose of increasing the productivity of checkout runs on the computer.

Task 2 - Compile and Check Program Code

As individual blocks of code are written in either symbolic assembly or procedure oriented languages, assemble or compile each block into machine readible form. Obtain listings and check for errors, correct the code and recompile, continuing this process until a satisfactorily compiled program or routine is obtained.

Task 3 - Test Individual Programs

Within the requirements set forth for program testing, plan, design, produce, and run performance tests of the individual programs to isolate and correct errors, rerunning the tests until

all program requirements and design specifications are satisfactorily met.

Task 4 - Test Program Subsystems

Within the context of the more general program system test plans, design, produce, and run program subsystem test for physical integration of functionally interdependent blocks of programs to isolate and correct failures of functional interactions and failures to meet program and design specifications.

Task 5 - Test Program System

Within the plans for the overall quality assurance of the programming system, design, produce, and run tests of the total program system to isolate and correct system malfunctions. These test are usually run in a series, increasing in size and complexity.

As previously mentioned, the tasks described are general in nature but applicable to all information systems development projects. Each task is comprised of numerous sub-tasks with additional effort required of the QDRI Project Team to develop and expand the list of sub-tasks.

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